THERMAL TRANSFER SHEET

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THERMAL TRANSFER SHEET

[Netsu tensha shihto]

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[There are no amendments to this patent.]

Claims /1*

1. A thermal transfer sheet having a base sheet, a short fiber temporary retention layer formed on said base sheet, a short fiber layer flocked on said short fiber temporary retention layer, a base sheet cover layer formed on the short fiber layer, a dissimilar surface material layer formed on said short fiber cover layer, a patterned adhesive retention layer formed on the short fiber layer in areas without the short fiber cover layer, and a dissimilar surface material layer and having a hot-melt adhesive layer formed on said patterned adhesive retention layer, which /2
thermal transfer sheet is characterized by the fact that said short fiber temporary retention layer has a release property with respect to the short fiber layer and an adhesive property with respect to the base sheet, and said short fiber cover layer has a release property for the dissimilar surface material layer and adhesive property for the short fiber temporary retention layer.

2. The thermal transfer sheet described in Claim 1 in which a coloring agent layer is provided between the short fiber layer in the area without the short fiber cover layer and the patterned adhesive retention layer.

3. The thermal transfer sheet described in Claim 1 or 2 in which said dissimilar surface material layer is a retention layer having fine metal strips that reflect light.

4. The thermal transfer sheet described in Claim 1, 2, or 3 in which said patterned adhesive retention layer is formed as a stitched design.

Detailed description of the design

Industrial application field

The present design pertains to a thermal transfer sheet used for thermal transfer of a design onto a base cloth.

Prior art and problems to be solved by the design /3

Formation of a flocked pattern by means of thermal transfer and formation of a design other than the flocked pattern, for example, a design based on a metal powder, using the thermal transfer method, has been known in the past.

However, simultaneous transfer of a flocked pattern and a design based on a dissimilar surface material such as a metal powder, has not been introduced to market at this point.

For example, in order to produce a thermal transfer sheet used for transferring a design based on short fiber m and a design based on metal powder n shown in Figure 8, a releasable

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* [Numbers in right margin indicated pagination in the original foreign text.]

short fiber temporary retention layer p is formed on the base sheet in the area to be provided with the short fiber pattern, flocking the short fiber is done to form short fiber layers q1 to q3 (Figure 9(a)); then, release layer r is formed in the remaining areas of the base sheet o, and an ink made of a binder containing a metal powder, etc., that is, metallic layer s made of a metallic ink, is provided on said release layer r (Figure 9(b)), short fiber layers q1 to q3 and adhesive retention /4
layer t for bonding of the metallic layer s are formed, then, hot-melt adhesive layer u for bonding with a fabric (Figure 9(c)) is formed on said adhesive retention layer t as shown in Figure 9(a) to (c) that shows cross-section diagrams corresponding to line V-V in Figure 8.

However, in order to produce a thermal transfer sheet provided with a variety of designs as described above, flocking of the short fiber based on the short fiber design of each design area is required and the procedure is complicated and inefficient. Furthermore, release layer r is provided after formation of the short fiber layers q1 to q3; thus, formation of release layer r, for example, at or near the boundary between the short fiber layers q1 to q3 is poor in the area where design m based on the short fiber and design n based on the metal powder come into contact; as a result, release of the metallic layer s at the time of thermal transfer is poor, and the outline of the design n based on metal powder is likely to be obscure. And furthermore, when a short fiber is used to represent a fine line, it is necessary to form the short fiber layers q1 and q2 themselves with a fine line in the area consisting of design n based on the metal powder shown in q1 and q2 of Figure 9(b), for example, but unlike the case of short fiber layer q3 formed as a surface, /5
distortion of the design is likely to occur as a result of tilting of the short fiber at the area based on the printing pressure at the time of printing of the adhesive retention layer t on fine line short fiber layers q1 and q2, and an adequate formation of hot-melt adhesive layer u is difficult and adhesion failure of the transferred pattern is likely to occur.

Needless to say, the short fiber is planted directly on the fabric, for example, to form a flocked pattern, and then, a metallic ink is dyed directly onto the fabric in areas without said flocked pattern and the flocked pattern and the metallic pattern are used in combination as well. However, matching of both designs is quite difficult and dislocation of designs is likely to occur. Furthermore, complicated processes such as direct planting, direct dyeing, drying, and heating are required, and adsorption of the short fiber to unwanted areas is likely to occur at the time of flocking, and complete removal of the fiber is impossible.

Variation in quality is significant in either of said methods and production efficiency /6
posed a problem.

The present design seeks to eliminate said problems of the prior art, and the purpose of the present design is to produce a thermal transfer sheet capable of achieving formation of a flocked design, and design based on a dissimilar surface material such as metal powder and

secure transferring can be done easily at the same time, forming a good transferred design and dissimilar surface material design, and furthermore, transferring can be achieved easily and securely.

Means to solve the problem

In order to achieve the above purpose, the thermal transfer sheet of the present design is a thermal transfer sheet characterized by the fact that said short fiber temporary retention layer has a release property with respect to the short fiber layer and an adhesive property for the base sheet, and said short fiber cover layer has release property for the dissimilar surface material /7
layer and adhesive property for the short fiber temporary retention layer in a thermal transfer sheet having a base sheet, a short fiber temporary retention layer formed on said base sheet, a short fiber layer flocked on said short fiber temporary retention layer, a base sheet cover layer formed on the short fiber layer, a dissimilar surface material layer formed on said short fiber cover layer, a patterned adhesive retention layer formed on the short fiber layer in areas without the short fiber cover layer and dissimilar surface material layer and a hot-melt adhesive layer formed on said patterned adhesive retention layer.

For the material used for the base sheet, cellulose paper, synthetic paper, cellophane paper, non-woven fabric, synthetic resin film, a synthetic resin sheet, etc. can be mentioned, and those having superior water repellency are suitable.

It is necessary for said short fiber temporary retention layer to have a release property with respect to the short fiber that comprises short fiber layer and an adhesive property with /8
respect to the base sheet, and for example, formation of the layer is made possible when a coating is applied to a part of the surface or the entire surface of said base sheet with a solution type, emulsion type, or dispersion type water-based or oil-based ink mainly comprising a thermoplastic polymer compound such as vinyl acetate resin, ethylene-vinyl acetate copolymer resin, vinyl acetate-vinyl chloride copolymer resin, vinyl chloride resin, acrylate type resin, polyurethane resin, polyester resin, polyamide resin, styrene butadiene latex and acrylonitrile butadiene latex and optional release agents such as carnauba wax, paraffin wax, polyethylene wax, polypropylene wax, silicon resin and fluororesin, starches such as ethyl cellulose, hydroxy propyl cellulose, carboxy methyl cellulose, casein, sodium alginate, starch powder and starch derivatives, desiccating agents, extender pigments, surfactants such as ethylene glycol, propylene /9
glycol, diethylene glycol, butyl glycol, glycerol, polyethylene glycol, polypropylene glycol, and urea using rolls, gravure, knife coating, or a second printing, etc.

Furthermore, said short fiber temporary retention layer may consist of multiple layers as well.

Production of said short fiber layer is made possible upon electrostatic flocking of a short fiber made of a material such as rayon, nylon, polyester, or a polyacrylic material onto a part or all of the surface before drying said short fiber temporary retention layer, and thorough drying of the short fiber temporary retention layer. It is desirable for said short fiber to have a length of 0.2 to 1.5 mm and thickness of 0.5 to 3.0 denier.

Said short fiber cover layer is formed on the short fiber layer in the area where a design with dissimilar surface materials is to be formed at a thickness that covers said area of the short fiber layer. Therefore, the short fiber in said area is buried under the short fiber cover layer. It is desirable for the short fiber cover layer to integrate with the short fiber group and to be bonded with the short fiber temporary retention layer. It is necessary for said short fiber cover layer to have a release property for the dissimilar surface material layer and an adhesive property for the short fiber temporary retention layer, and for the material used, those listed for said short fiber /10
temporary retention layer may be used. Furthermore, said short fiber cover layer may consist of multiple layers as well.

The dissimilar surface material layer is formed on a part or all of the short fiber cover layer. Formation of said dissimilar surface material layer is made possible when screen printing is done with an ink produced by adding metallic light-reflecting fine pieces such as graphite-type pearl pigments, bronze powder (gold power), aluminum power (silver power), and fine pieces of a metal-deposited synthetic resin film (glitter) as a dissimilar surface material, in addition, fine pieces of colored or non-colored ceramic, glass, minerals, wood, natural and synthetic resins, and other optional materials such as desiccating agents, surfactants, pigments and anti-corrosive agents to one or more different types of thermoplastic resin polymer compounds listed for said /11
short fiber temporary retention layer, in particular, vinyl acetate resin, ethylene-vinyl acetate copolymer resin, acrylate type resin, polyurethane resin, styrene butadiene latex, and acrylonitrile butadiene latex. It is desirable when the particle diameters of the fine pieces used as the dissimilar surface material are in the range of approximately 10 to 120 μm. Furthermore, it is possible to use the thermoplastic polymer compound itself as a dissimilar surface material, or a thermoplastic polymer compound containing conventional dyes, conventional pigments, luminous pigments, temperature sensitive dyes, photochromic dyes, etc. may be used as a dissimilar surface material as well.

When the dissimilar surface material layer is made of a metal light reflective fine-piece retention layer that retains said metal light reflective fine pieces, formation of a highly decorative metallic light-reflective design can be achieved. Furthermore, many different types of dissimilar surface material layers may be formed as well.

The patterned retention layer design is formed on a part or all of the short fiber layer in areas without the short fiber cover layer and the dissimilar surface material layer. Areas without the short fiber cover layer on the short fiber layer are formed in correspondence to the shape of the short fiber design, and the area where the patterned adhesive retention layer design is formed produces the base sheet design after thermal transfer. The shape of the dissimilar surface material layer is formed in correspondence to the shape of the dissimilar surface material design, and the /12
area where the patterned adhesive retention layer design is formed structures the dissimilar surface material design after thermal transfer. Retention of the dissimilar surface material layer at the time of transfer and processes that follow is made secure by said patterned adhesive retention layer design, and the sharpness of the outline of the design on the dissimilar surface material is increased.

Formation of said patterned adhesive retention layer design is made possible with an essentially colorless ink produced by adding adhesives, desiccating agents, and melamine type, urea type or polyisocyanate type crosslinking agents to said thermoplastic polymer compounds. For said printing ink, in addition to said components, coloring agents such as standard pigments, fluorescent dyes, and white pigments may be added to form a colored printing ink.

For example, formation of said hot-melt adhesive layer is made possible when a hot-melt thermoplastic polymer compound powder such as ethylene-vinyl acetate copolymer resin, nylon /13
resin, polyester resin, polyacrylate resin, and polyurethane resin is scattered over the entire area of said patterned adhesive retention layer design before drying said patterned adhesive retention layer. Removal of the powder adsorbed to areas other than the patterned adhesive retention layer can be easily achieved after drying said patterned adhesive retention layer.

When a coloring material layer is formed between the short fiber layer in the area without the short fiber cover layer and the patterned adhesive retention layer, bright color or deep color can be provided for the short fiber on the short fiber layer. Formation of said coloring material layer is made possible with an ink produced by adding desiccating agents and other additives, standard pigments, fluorescent pigments, white dyes, and other coloring agents to said thermoplastic polymer compounds. In this case, the shape of the patterned adhesive retention /14
layer design is formed in correspondence to the shape of the short fiber design on part or all of the coloring material layer. In this case, the patterned adhesive retention layer may retain the short fiber layer directly or via the coloring material layer. It is desirable for the viscosity of the coloring material layer to be low from the standpoint of high penetration of the short fiber layer and high dye affinity.

After forming said short fiber temporary retention layer, short fiber layer, short fiber cover layer, dissimilar surface material layer, patterned adhesive retention layer, and hot-melt

adhesive layer and/or coloring material layer on the base sheet as described above, it is desirable for a heat-treatment to be applied to the entire layer for 0.5 to 10 min at 80 to 200°C. When said heat-treatment is provided, a design pattern formed on the fabric by means of thermal transfer with a sharp outline and high adhesion to the transfer object with excellent washability and wear resistance is possible.

In order to produce a flocked design and dissimilar surface material design on a variety of transfer objects such as fabrics that comprise clothing, interior products, everyday items, etc. with the thermal transfer sheet produced as described above, the surface of the hot-melt adhesive /15
layer is brought into contact with the transfer object, and an iron or heat press is applied from the base sheet side for 5 to 60 sec at a temperature of 80 to 200°C and pressure of 10 to 500 g/cm^2, and the base sheet is removed while hot or after cooling. At this time, the short fiber temporary retention layer and short fiber cover layer are removed essentially as an integral unit with the base sheet and the flocked design or dissimilar surface material design appears on the transfer object.

When the patterned adhesive retention layer design is formed to simulate a stitching pattern, a stitched base sheet design and embroidery design consisting of the dissimilar surface material design can be obtained after the transfer.

Effect of the design

In the thermal transfer sheet of the present design, a complicated process where restriction on the short fiber layer is not required for each short fiber layer formed according to a variety of designs where a short fiber design and a dissimilar surface material design are used in combination, and the patterned design adhesive retention layer is formed on the short fiber layer in the area where the flocked design is required, and the short fiber cover layer is formed on the short fiber layer where the dissimilar surface material design is required and the dissimilar surface material layer is formed on the surface, and the patterned adhesive retention layer is formed; thus, efficient production is possible. And furthermore, in the thermal transfer sheet of /16
the present design, the flocked design and dissimilar surface material design can be easily and securely produced simultaneously, and an excellent design pattern with a sharp outline and accurate shape is made possible even in areas where the flocked pattern and dissimilar surface material pattern meet.

When a coloring agent layer is provided between the short fiber layer where the short fiber cover layer is absent and patterned design adhesive retention layer, a bright color or deep color can be provided for the short fiber on the short fiber layer.

Furthermore, when a metallic light-reflective fine piece retention layer is used as the dissimilar surface material layer, a three-dimensional effect based on the flocked pattern and metallic light-reflective pattern based on the metallic light-reflective fine pieces where the metallic light-reflective pattern appears to float on the surface or a high-quality effect based on the combination can be achieved and excellent decorative effect can be achieved.

Furthermore, when the patterned design adhesive retention layer is formed to simulate the stitching pattern, a complicated embroidery design applied to high-quality products by a skilled worker that requires a long time can be easily transferred to a variety of transfer objects such as /17
fabrics that form clothing, interior products, everyday items, etc. in a short time without any skill.

Furthermore, formation of the patterned design adhesive retention layer having a stitch-like design can be easily formed by a conventional means such as screen printing, and unlike conventional embroidery, mass production at low cost can be easily achieved; thus, a combination of the flocked design that appears to be embroidery and dissimilar surface material design that appears to be embroidery can be applied at a relatively low cost and the value of the product can be significantly increased.

Furthermore, unlike the case of embroidery, it is not necessary to use the thread backside of the transfer object in said design that appears to be embroidery formed on the transfer object by said thermal transfer sheet; thus, the thread on the backside does not interfere with wearing or removal of clothing or rupturing of the embroidery design as a result of rupturing of the thread on the backside.

Application examples

The present design is explained in further detail below with specific working examples /18
and drawings. In this case, "parts" in working examples represent "parts by weight."

Application Example 1

As shown in Figure 1 that represents a schematic cross section view of an example of the thermal transfer sheet of the present design, a printing ink consisting of 30 parts of Bes Resin A-5151G [transliteration] (trade name, polyester resin emulsion, product of Takamatsu Fats and Oils Co. (Ltd.)), 62 parts of Extender OS (trade name, a diluent for water-based inks consisting of mineral spirits, water, and a surfactant, product of Matsui Pigments and Chemicals Co. (Ltd.)), 3 parts of Silicone SH-200 (trade name, silicone type water repellent agent, product of Toray Silicone Co. (Ltd.)), 3 parts of urea and 2 parts of ethylene glycol was coated over the entire

surface of base sheet 1 made of a polyester film with a thickness of 100 μm using full screen plate (80 mesh) to form short fiber temporary retention layer 2.

Before said short fiber temporary retention layer 2 dried, electrostatic flocking was applied to the surface with a white rayon pile (length of 0.5 mm, 1.5 denier) at a ratio of approximately 90 g/cm^2 to form short fiber layer 3.

Furthermore, printing of short fiber layer 3 was done with a printing ink consisting of /19
40 parts of A-5151G, 40 parts of Extender OS, 8 parts of water, 2 parts of Silicone SH-200, 3 parts of ethylene glycol, 2 parts of urea and [illegible] parts of Emulgen [transliteration] 507 (trade name, permeable surfactant, product of Kao Co. (Ltd.)) with a screen printing plate (70 mesh) to produce short fiber cover layer 4 that permeates the short fiber temporary retention layer 2 and covers short fiber layer 3 at the same time.

Furthermore, for the vehicle consisting of 15 parts of Matsuminzol [transliteration] MR-96 (trade name, acrylate type resin, product of Matsui Pigment and Chemical Co. (Ltd.)), 60 parts of Extender OS, [illegible] parts of water and 3 parts of ethylene glycol, 2 parts of Neo-Blue [transliteration] MB, 2 parts of Neo-Yellow [transliteration] MGR and 2 parts of Neo-Red [transliteration] MGD (trade name, organic aqueous dispersions, all products of Matsui Pigment and Chemical Co. (Ltd.)), each was added to produce 100 parts of three colored inks; then, printing was done for short fiber layer 3 in the areas without short fiber cover layer 4 with said three colored inks using a [illegible] mesh screen plate so as to form colored layers /20
5a, 5b, and 5c.

Furthermore, printing of a design was done on the short fiber cover layer 4 with an ink consisting of [illegible] parts of LG [transliteration] Red Gold (200 mesh pass gold power, product of Oike Co. (Ltd.)), 32 parts of Sumika Flex [transliteration] 900H (trade name, acrylate type resin, product of Sumitomo Chemical Co. (Ltd.)) and 50 parts of Extender OS with a 50 mesh screen printing plate so as to form metallic light-reflective fine piece retention layer 6 (dissimilar surface material layer).

Furthermore, design printing was done for coloring agent layers 5a, 5b, and 5c and the metallic light-reflective fine-piece retention layer 6 with a printing ink consisting of 90 parts of Matsuminzol [transliteration] F23C (trade name, acrylate type resin, product of Matsui Pigment and Chemical Co. (Ltd.)), 3 parts of Sumitex [transliteration] Resin M-3 (trade name, melamine type crosslinking agent, product of Sumitomo Chemical Co. (Ltd.)), 1 part of ammonium chloride, 1 part of aqueous ammonia, 3 parts of ethylene glycol and 2 part of urea with 100 mesh screen printing plate so as to produce patterned design adhesive retention layer 7.

And furthermore, before said patterned design adhesive retention layer 7 dried, Diamide [transliteration] T-450P-3 (trade name, nylon resin power, product of Daisel Chemical Co. /21

(Ltd.)) was sprinkled onto said layer to form hot-melt adhesive layer 9, and excess power was removed after drying, and a heat-treatment was applied for 5 min at 150°C to produce a thermal transfer sheet.

The hot-melt adhesive layer 9 side of said thermal transfer sheet was applied to the front side 10 of a sportswear, and heat press was applied for 20 sec at 160°C and 50 g/cm^2; then, base sheet 1 was removed integrally with short fiber temporary retention layer 2 and short fiber cover layer 4.

As a result, it was possible to produce a highly decorative design pattern having a three-dimensional effect based on the short fiber and high-quality look of metallic color shown in Figure 2 and Figure 3 (a schematic cross-section view at line I-I of Figure 2) on the front side 10 of sportswear.

Application Example 2

A printing ink consisting of 70 parts of Binder 50R (trade name, acrylate type resin, Matsui Pigment and Chemical Co. (Ltd.)), 2 parts of Silicone SH-200, 3 parts of ethylene glycol, 2 parts of urea and 23 parts of Extender OS was coated onto the entire surface of base sheet /22
made of a high-quality paper (120 g/m^2) using full screen plate (80 mesh) to form short fiber temporary retention layer.

Immediately, electrostatic flocking was done for said short fiber temporary retention layer with a white nylon pile (length of 0.8 mm, 1.5 denier) to form a short fiber layer and drying was performed for said short fiber temporary retention layer.

Furthermore, printing was done for said short fiber layer with a printing ink consisting of 94 parts of Binder 50R, 2 parts of Silicone SH-200, 1 part of ethylene glycol, 1 part of urea and 60 parts of Emulgen [transliteration] A-60 with a screen printing plate (70 mesh) so as to produce a short fiber cover layer.

Furthermore, for the vehicle consisting of 15 parts of Matsuminzol [transliteration] MR-96, 60 parts of Extender OS, 20 parts of water, 1 part of ethylene glycol, 1 part of urea and 2 parts of Emulgen [transliteration] A-60, 1 part of Neo-Blue MR and 1 part of Neo-Red MGD each was added to produce 100 parts of two types of colored inks; then, printing was done for the short fiber layer in areas without short fiber cover layer with said two types of colored inks using /23
an 80 mesh screen plate so as to form colored layers.

Furthermore, printing of the design was done for said short fiber cover layer with an ink consisting of 15 parts of aluminum-deposited polyester film fine pieces (length of 100 μm), 20 parts of Iodozol LD1009 (trade name, acrylate type resin, product of Kanebo NSC Co. (Ltd.)), 1 parts of ethylene glycol, 1 part of urea, 40 parts of Extender OS and 23 parts of water with a 30

mesh screen printing plate so as to form a metallic light-reflective fine piece retention layer (dissimilar surface material layer).

Furthermore, design printing was done for the metallic light-reflective fine-piece retention layer and coloring agent layer with a printing ink consisting of 95 parts of Iodozol LD1009, 3 parts of Sumitex [transliteration] Resin M-3, 1 part of ammonium chloride, and 1 part of aqueous ammonia with 80 mesh screen printing plate to produce a patterned design adhesive retention layer.

Immediately, Vilon [transliteration] GM (trade name, polyester resin power, product of Toyobo Co. (Ltd.)) was sprinkled over the entire surface of said patterned adhesive retention layer, and excess power was removed after drying to produce a hot-melt adhesive layer.

Furthermore, a heat-treatment was applied for 3 min at 140°C to produce a thermal /24
transfer printing sheet.

The hot-melt adhesive side of said thermal transfer printing sheet was applied to the front side of a winterizing short coat, and heat press was applied for 20 sec at 160°C and 150 g/cm^2, and when the base sheet was removed integrally with the short fiber temporary retention layer and short fiber cover layer, and it was possible to produce a highly decorative pattern having a three-dimensional effect based on the short fiber and the high-quality look of a metallic color.

Application Example 3

As shown in Figure 4, which represents a cross-section diagram of an example of the thermal transfer sheet of the present design, a printing ink consisting of 20 parts of Hydran [transliteration] AP-20 (trade name, polyurethane type resin emulsion, product of Dainippon Ink and Chemical Co. (Ltd.)), 10 parts of Unicon [transliteration] PM-70 (trade name, carnauba wax emulsion, product of Union Chemicals Co. (Ltd.)), 50 parts of Extender OS, 15 parts of water, 2 parts of diethylene glycol, and 3 parts of urea was coated over the entire surface of base sheet 11 made of a polyester film with a thickness of 100 μm using a full screen plate (80 mesh) to /25
form short fiber temporary retention layer 12.

Before said short fiber temporary retention layer 12 dried, electrostatic flocking was applied to the entire surface with a white rayon pile (length of 0.8 mm, 1.5 denier) at a ratio of approximately 100 g/cm^2 to form short fiber layer 13. Furthermore, printing was done for short fiber layer 13 (a) of short fiber layer 11 shown as the top view in Figure 5 with a printing ink consisting of 25 parts of Hydran [transliteration] AP-20, 10 parts of Unicon PM-70, 45 parts of Extender OS, 16 parts of water, 2 parts of ethylene glycol and 2 parts of Emulgen A-60 with a screen printing plate (80 mesh) to produce short fiber cover layer 14.

Furthermore, printing was done for the entire surface of short fiber cover layer 14 with an ink consisting of 15 parts of silver powder (non-leaf type aluminum powder, 100 mesh pass), 30 parts of Rika-Bond [transliteration] FK-555 (trade name, acrylate type resin emulsion, product of Chuo Rika Co. (Ltd.)), 53 parts of Extender OS and 2 parts of ethylene glycol with a /26
60 mesh screen printing plate to form metallic light-reflective fine-piece retention layer 15.

Furthermore, two types of ink consisting of 96 parts of Binder 200R (trade name, acrylate resin emulsion, product of Matsui Pigment and Chemical Co. (Ltd.)), 2 parts of Emulgen 507, 2 parts of Neo-Red MGD or Neo-Green MY (trade name, both are organic pigment aqueous dispersion, product of Matsui Pigment and Chemical Co. (Ltd.)) were prepared and screen printing was performed for the entire area of short fiber layer 13 shown by (b) and (c) in Figure 5 with 80 mesh screen to produce coloring agent layers 16a and 16b.

Furthermore, design printing was done with an ink consisting of 90 parts of Matsuminsol F23C, 3 parts of Sumitex Resin M-3, 1 part of ammonium chloride, 1 part of aqueous ammonia, 3 parts of ethylene glycol and 2 parts of urea with a 100 mesh screen printing plate engraved with dots and lines with a thickness of 0.5 to 0.8 mm for the area of coloring agent layers 16a and 16b and dots and lines of approximately 1.0 mm for the area of metallic light-reflective fine-piece retention layer 15 so as to form a stitch designed patterned design adhesive retention layer 17.

Immediately, Diamide [transliteration] T-450P-3 was sprinkled onto the surface of said /27
patterned design adhesive retention layer 17 so as to form hot-melt adhesive layer 19, and excess power was removed after drying, and a heat-treatment was further applied for 5 min at 150°C so as to produce a hot-melt adhesive layer.

The hot-melt adhesive layer side of said thermal transfer sheet was applied to the front side 20 of sportswear (cotton material), and a heat press was applied for 20 sec at 160°C and 50 g/cm^2; then, the base sheet was removed. As a result, it was possible to produce an embroidery design where stitched short fiber design and stitched dissimilar surface material design are used in combination as shown in Figure 6 and Figure 7 (a cross-section diagram at line II-II of Figure 6) on the front side of the sportswear.

Brief description of the figures

Figure 1 to Figure 3 concern one example of the thermal transfer sheet of the present design, and Figure 1 is a schematic cross-section view, Figure 2 is a top view of the transferred design and Figure 3 is a schematic cross-section view at lines I-I of Figure 2.

Figure 4 to Figure 7 concern a different example of the thermal transfer sheet of the present design, and Figure 4 is a schematic cross-section view, Figure 5 is a top view of base /28

sheet, Figure 6 is a top view of the transferred design, and Figure 7 is a schematic cross-section view at line II-II of Figure 6.

Figure 8 and Figure 9 (a) to (c) concern a thermal transfer sheet of the prior art, and Figure 8 is a top view of the transferred design, and Figure 9 (a) to (c) are schematic cross-section views of the production process of the thermal transfer sheet.

In the figures, 1 and 11 are base sheets, 2 and 12 are short fiber temporary retention layers, 3 and 13 are short fiber layers, 4 and 14 are short fiber cover layers, 5a, 5b, and 5c, 16a and 16b are coloring agent layers, 6 and 15 are metallic light-reflective fine-piece retention layers (dissimilar surface material layer), 7 and 17 are patterned design adhesive retention layers and 9 and 19 are hot-melt adhesive layers.

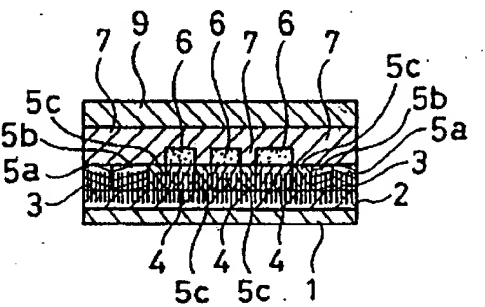

Figure 1

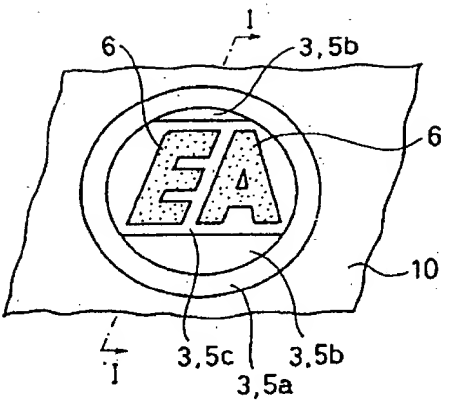

Figure 2

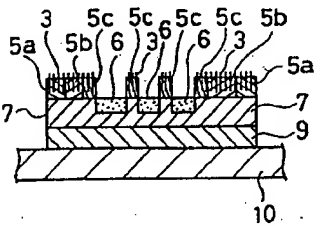

Figure 3

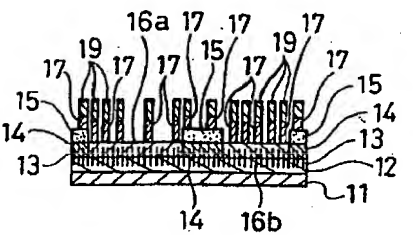

Figure 4

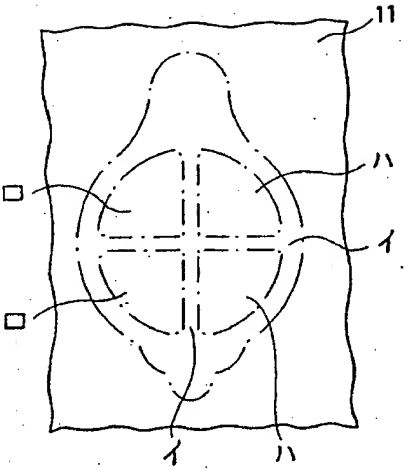

Figure 5

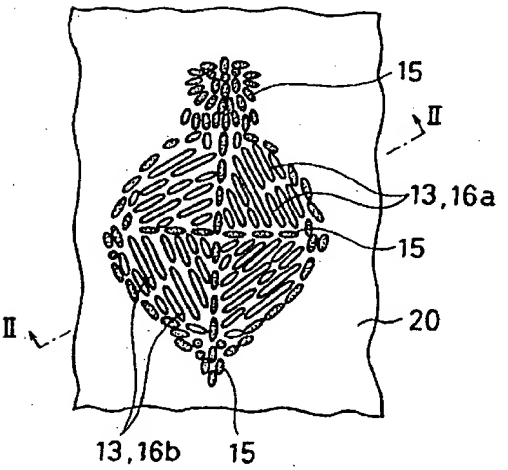

Figure 6

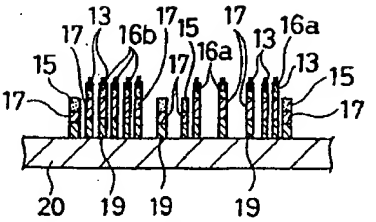

Figure 7

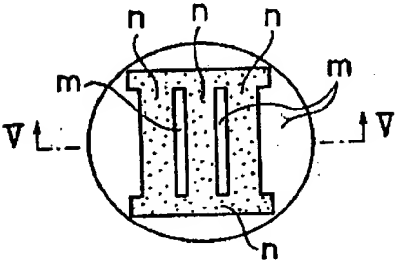

Figure 8

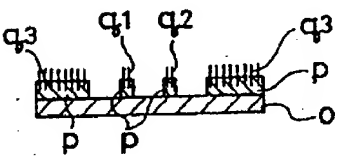

Figure 9A

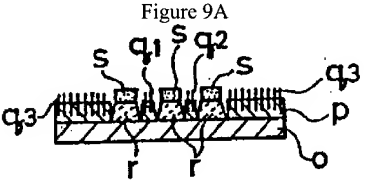

Figure 9B

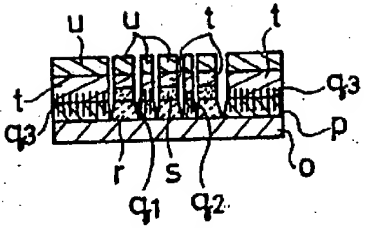

Figure 9C